Chapter 1

An Introduction To Energy

What is energy?

Energy is what makes things work. When we flip on a light switch, we use energy. We use energy riding a bus to school. Listening to a favorite song on a CD player uses energy. Try to imagine a world without energy. There would be no TV, no computers and no cars. Energy is what makes our lives comfortable and prosperous.

Where does energy come from?

A major source of energy is the sun. The sun's light and heat are both forms of energy. Plants use the sun's energy to grow. When we eat plants, we take in their energy. This gives us the energy to think and learn. It also gives us muscle power.

Wind and water also are energy sources. So too are oil, coal, natural gas and things that grow. You may be familiar with nuclear energy, as well. Nuclear energy, produce from uranium (a mineral found in the ground), is popularly used in South Carolina to produce electricity, another form of energy.

Energy's Role in History

Because energy is basic to our lives, it is at the very heart of civilization. Prehistoric people learned to use fire's heat energy. They used it to take away the night's chill, to cook food and to fashion tools.

The ancient Egyptians discovered there was energy in wind. They used it to sail their ships. By the first century B.C., people had learned to

use the energy power of water. The water wheel harnessed the energy of moving water. Water power was stronger than the muscle power of both people and animals combined.

The principle behind the water wheel was also applied to wind. Windmills popped up in the lowlands of Europe. Using only the wind for power, windmills ground grains into flour. In areas far from the seas, wind power became an important energy resource.

By the 1800s, civilization searched for more energy resources. People, work animals (such as horses and oxen) and wood were no longer enough. While water and wind power continued to fill many energy needs, they were unreliable.

The answer to this quest came in the form of James Watt's invention of the steam engine.

Steam, produced from burning wood or coal, took industry indoors. Workers left their rural homes for work in big city factories. The Industrial Revolution pushed civilization "full steam" ahead.

Other energy inventions followed. One exciting idea seemed to spark another. Work by physicists in Europe and experiments by Thomas Edison in New Jersey led to the invention of the light bulb in 1879. By 1882, New York's Pearl Street generator was routinely sending electricity into homes.

Pictured above: *Thomas Edison's electric light bulb.*

Our Changing Energy Needs

Inventions and industrialization also changed our energy needs. In Colonial times, wood was the chief fuel used in the U.S. By the 1850s, wood was still filling 90 percent of our energy requirements. Coal was also becoming an important fuel, since it powered the steam engines that ran factories.

Growing Strong With Energy

All of this changed in 1859 with the invention of the internal combustion engine. The gasoline-driven, fossil fuel-burning internal combustion engine became the foundation for the "horseless carriage." Cars transformed American society forever. Their huge popularity made gasoline the driving energy force in our economy.

For the first two-thirds of the 20th century, America was the undisputed technological king of the world. Our prospering economy, even after two World Wars, was built on our many energy resources. Americans consumed petroleum, natural gas, coal and wood with confidence that these resources would not run out. Nuclear energy also became an important resource. Americans were unmatched in their ability to use energy of all types. By 1970, 210 million Americans used more energy just for air conditioning alone than the 800 million people in China used to fill all of their energy needs.

The Oil Crisis of 1973

Then came the Oil Crisis of 1973. Politics suddenly controlled energy resources. Because the U.S. politically supported Israel, the oil-rich Arab countries stopped selling us oil. Everyone felt the impact of the oil shortage. We had become so used to using oil to run our cars and heat our homes and generate our electricity, we hardly knew how to get through our daily lives without it. Airlines cut back on flights. Vacations were canceled. Administrators thought about shortening the school year. Workers lost jobs. For the first time, people stopped taking energy for granted.

Our Energy Future

Fortunately, that crisis ended in 1974. Perhaps even more fortunately, we learned important lessons. We then knew our energy supplies were not limitless. Petroleum, in particular, will not always be plentiful and inexpensive.

In response, we have developed technologies that make better use of our resources. Appliances and homes have become more energy efficient. Scientists have also looked to previously untapped resources as alternative energy sources, like the use of waste products for fuels.

The Oil Crisis of 1973 taught us to rethink the way we use energy. While energy use is still considered a sign of progress, energy waste is now regarded as both shortsighted and thoughtless. Through conservation, we can lessen our dependence on foreign suppliers of energy, and prolong the life of those resources we have.

In South Carolina, these lessons have been put into action. You have an opportunity in "The Energy Factbook" to explore the world of energy in depth. Energy is something we must think about today and plan for tomorrow. It concerns us all.

An Energy Time Line

- **4.5 billion years ago** — Solar energy reaches the earth.
- **1st century B.C.** — Water wheels harness the power of moving water.
- **5th century A.D.** — Windmills are first used in Persia.
- **1807** — James Watt's steam engine ushers in the Industrial Revolution.
- **1859** — First oil well is built in the U.S.
- **1859** — Jean Lenoir invents the internal combustion engine.
- **1879** — Thomas Alva Edison invents the light bulb and lights up the world.
- **1893** — Henry Ford builds his first "horseless carriage" – the automobile.
- **1903** — Wright Brothers fly a gasoline-powered airplane.
- **1942** — U.S. Scientist Enrico Fermi engineers a nuclear reaction.
- **1952** — Solar cells are invented.
- **1973** — Worldwide oil crisis occurs.
- **1977** — U.S. Department of Energy created.
- **1979** — Three Mile Island nuclear accident occurs.
- **1980** — First U.S. wind farm built.
- **1986** — World's worst nuclear accident to date happened at the Chernobyl reactor complex in the former Soviet Union.
- **1990** — Iraq invades oil-rich Kuwait, creating major international crisis.
- **1998** — California opens the deregulated electricity market.
- **2000** — "Rolling blackouts" plague California and Nevada.
- **2003** — The Blackout of 2003 darkens the northeastern United States and parts of Midwest and Canada, affecting 50 million people and causing more than $1 billion in damages.

ENERGY MEASUREMENT EQUIVALENTS

1 ton	2,000 pounds
1 barrel (oil)	42 gallons, or 5.6 cubic feet
1 Watt (W)	A metric unit of electrical power; the product of voltage and current
1,000 Watts	1 kilowatt (kW)
1,000 kilowatts	1 megawatt (mW)
1 kilowatt hour (kWh)	1000 watts of power used for one hour of time; equals 3,413 Btu
1,000 kilowatt hours	1 megawatt hour (mWh)
1 quad	one quadrillion Btu
1 Btu	Quantity of heat required to raise the temperature of one pound of water by one degree Fahrenheit.
1,000 Btu	1 kBtu
1 therm (natural gas)	100,000 Btu
1 Ccf (100 cubic feet – natural gas)	1.03 therms
1 Mcf (1,000 cubic feet – natural gas)	1,030,000 Btu
1 gallon	3.785 liters
1 MMBtu	1,000,000 Btu

ENERGY CONVERSION STATISTICS

Carbon dioxide emissions for 1 kWh	1.5 pounds
Coal required to produce 1 kWh	1 pound
Average U.S. cost of 1 kWh	6.64 cents
Average annual gallons of gasoline used per car	500 gallons
Average annual heat savings using 1 low-flow shower head	466 kWh

BTU CONVERSION FACTORS

FUEL TYPE	BTU
Electricity (kilowatt hours)	11,600
Fuel Oil (No. 2) – gallon (diesel fuel, home heating oil)	138,400
Fuel Oil (No. 6) – gallon (industrial heating oil)	153,600
LPG (liquefied petroleum gas – propane)	95,475
Coal (ton)	24,500,000
1 kilowatt hour	11,000
1 barrel of oil	6,250,000